

# Radio Science Support

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*Since 1967, radio scientists have used the DSN 26- and 64-m antenna stations to investigate pulsars, to study the effects of solar corona on radio signals, and to observe radio emissions from X-ray sources. More recently, very long baseline interferometry (VLBI) techniques have been used for high-resolution studies of quasars. During the reporting period, VLBI observations were made in support of investigations of quasars and the application of VLBI techniques to Earth Physics problems. Support was also provided for preliminary investigation of the mapping of spiral galaxies.*

## I. Introduction

The 26- and 64-m antenna stations of the DSN have been used for several years to support radio science experiments. NASA, JPL, and university scientists have used key DSN facilities whose particular and unique capabilities were required for the performance of the experiments. In order to formalize the method of selecting experiments and experimenters, a Radio Astronomy Experiment Selection (RAES) Panel was formed in 1969. Notice of availability of these facilities was placed in professional journals to inform the scientific community that they were available for limited use by qualified radio scientists (Ref. 1). No charge is made for use of the standard DSN facilities and equipment; special equipment, however, must be provided by the experimenters. A summary of all experiments conducted through April

1971 was reported in Ref. 2. Activities through June 1971 are reported in Ref. 3.

## II. Radio Science Operations

Table 1 shows experiments supported in September and October 1971. The X-band very long baseline interferometry (VLBI) observations continued the investigation of the structure of the quasars 3C273 and 3C279. In addition, it took advantage of the solar occultation of 3C279 to investigate further the relativistic effects first sought in October 1970.

Initial investigations of spiral galaxy mapping were conducted by H. Arp, using the 26-m antenna at 13 cm. This preliminary work confirmed that the goals can be

attained by use of the 64-m antenna and will require its use for the necessary resolution and sensitivity. Several new sources may also have been found.

### III. RAES Panel Activities

The RAES Panel approved the proposal for the experiment shown in Table 2. The experiment makes use of the 64-m antenna, X-band maser, and noise-adding radiometer.

### IV. OSSA Program Support

The DSN also provides support and use of the facilities for NASA programs of the Office of Space Sciences and Applications (OSSA). Initial support of a feasibility

demonstration for application to Earth Physics of VLBI techniques was provided in January of 1971 (Ref. 4). In this demonstration two Goldstone tracking stations, the 26-m Echo Station and the 64-m Mars Station, were equipped with JPL hydrogen maser frequency systems and operated in electrically independent, although coordinated, observing modes. Using the short baseline, the feasibility of potential application to Earth Physics problems of position location was demonstrated. On September 1, 5, 10, and 22, DSN support was provided for Earth Physics VLBI observations using the 64-m antenna at Goldstone and the 26-m antenna at DSS 62 in Spain. These observations were of a number of celestial radio sources. The feasibility of using a spacecraft for source was demonstrated on October 17 using *Mariner 9*, while observing it from the Mars and Echo Stations simultaneously to obtain VLBI data.

## References

1. *Bull. Amer. Astronom. Soc.*, Vol. 2, No. 1, p. 177, 1970.
2. Linnes, K. W., Sato, T., and Spitzmesser, D., "Radio Science Support," in *The Deep Space Network Progress Report*, Technical Report 32-1526, Vol. III, pp. 46-51. Jet Propulsion Laboratory, Pasadena, Calif., June 15, 1971.
3. Linnes, K. W., "Radio Science Support," in *The Deep Space Network Progress Report*, Technical Report 32-1526, Vol. V, pp. 42-44. Jet Propulsion Laboratory, Pasadena, Calif., Oct. 15, 1971.
4. Fanselow, J. L., et al., "The Goldstone Interferometer for Earth Physics," in *The Deep Space Network Progress Report*, Technical Report 32-1526, Vol. V, pp. 45-57. Jet Propulsion Laboratory, Pasadena, Calif., Oct. 15, 1971.

**Table 1. Radio science experiments involving 64- and 26-m antenna facilities**

Experiment	Purpose	Experimenter	DSN facility	Date
Quasar structure by X-band VLBI	To monitor time variations and fine structure and apparent position of quasars.	T. Clark (GSFC) R. Goldstein (JPL) H. Hinteregger (MIT) C. Knight (MIT) G. Marandino (University of Maryland) A. Rogers (MIT Haystack Observatory) I. Shapiro (MIT) D. Spitzmesser (JPL) A. Whitney (MIT)	DSS 14 (and MIT Haystack antenna)	June 9, 19, 1971 Sept. 19, 1971 Oct. 2-4, 10, 17, 1971
Spiral galaxy mapping	To study galaxies with anomalous red shifts and their possible association with radio sources.	H. Arp (Caltech)	DSS 13 (26 m)	Oct. 4, 7, 13, 20, 27, 1971

**Table 2. Recent experiments approved by the RAES Panel**

Experiment	Purpose	Experimenter	DSN facility
Small scale variations in cosmic background radiation.	Search for small-scale spatial variations in the 2.7°K cosmic background radiation at 3.5 cm.	R. Carpenter (Calif. State College at Los Angeles) S. Gulkis (JPL) T. Sato (JPL)	DSS 14